

THE TREATMENT OF PARAQUAT POISONING : THREE CASES OF RECOVERY

by

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THREE cases of recovery from paraquat poisoning are reported. In cases of this sort small amounts of a dilute preparation are not usually fatal. Larger amounts of concentrated preparations are invariably fatal but with very small amounts of concentrated preparations the outcome is often unpredictable. It is suggested that in such cases all measures to prevent absorption, increase excretion, maintain the patient and prevent progressive renal, hepatic and pulmonary damage are justified.

CASE REPORTS

Case No. 1

A 33-year-old man was admitted to an Intensive Care Unit one hour after taking about 30 ml. of "Weedol" (5 per cent paraquat) as well as a mixture of sedatives and anti-epileptic tablets. He was a transvestite with a history of psychiatric treatment. On admission he was given a litre of 7 per cent Bentonite by stomach tube. When seen 11 hours later, he was fully conscious. He was not jaundiced, had no mouth ulcers and was afebrile. His chest was clear clinically. His blood pressure was 116/75 mm Hg. His pulse was 80 per minute and regular. His blood urea was 33 mg%. Paraquat levels in 2 urinary samples the day after admission were 470 ug/100 ml., and 180 ug/100 ml., respectively.

The patient passed no urine for 24 hours after admission, due to retention, but passed adequate amounts after catheterization. He made a full recovery with no evidence of renal or respiratory damage. A chest x-ray showed no active lung lesion although there was a calcified focus in the left lower zone with some calcified left hilar glands. The patient was still physically well five months after discharge when he was readmitted following another overdose; this time he seemed to have avoided paraquat!

Case No. 2

A 56-year-old man was admitted to an Intensive Care Unit 12 hours after taking a mouthful of "Dextrone" weedkiller (a combination of paraquat and diquat) which he spat out at once. Shortly afterwards gastric lavage was performed and after another 4 hours one litre of 7% Bentonite was instilled in a Casualty Department. On admission he was fully conscious and appeared well, although he had begun to suffer from diarrhoea a few hours before arrival. There was no mouth ulceration, no jaundice and no abdominal tenderness. The chest was clear. The blood pressure was 170/80 mm Hg., and the pulse was 80 per minute. There was a low grade pyrexia which persisted for 2 weeks. The day after admission the patient developed a sore throat and dysphagia, later coughing up some blood. He passed only 100 ml. of urine in the first 12 hours but thereafter produced adequate amounts. The blood urea was 170 mg/100 ml. on admission. It gradually fell to a normal level over a period of 3 weeks. The serum creatinine was 1.8 mg/100 ml. 5 days after admission. The serum S.G.O.T. reached a level of 159 K units, L.D.H. 370 W.L. units and alkaline

phosphatase 48 K.A. units 2 weeks after admission. The serum bilirubin was not raised at any time. Serial chest x-rays showed no lung lesion. The serum paraquat was not estimated. Urinary paraquat was measured in samples taken between the tenth and sixteenth days. The highest level detected was only 21 ug/100 ml., and in several samples no paraquat was found.

The patient made a good recovery despite developing thrombophlebitis in the right axillary vein where he had had an initial intravenous infusion. He was discharged eighteen days after admission and when seen 2 weeks later had a normal blood urea and serum creatinine. One month later he remained well.

Case No. 3

A 52-year-old man was admitted to an Intensive Care Unit. He gave a history of splashing his face and mouth with "Gramoxone W" (20 per cent paraquat) from a can of weedkiller about 3 days before. He at once washed his face, mouth and hands. The next day he developed discomfort in his mouth and throat and began to have difficulty in swallowing. He had passed very little urine in the 2 days before admission. On examination he was fully conscious and afebrile. He was slightly cyanosed and had a rapid respiratory rate, but his chest was clinically clear. There was ulceration of the buccal mucosa and severe ulceration of the mucosa over the fauces and pharynx. He had difficulty in swallowing even saliva. The pulse was 120 per minute and the blood pressure 120/80 mm Hg. There was no abdominal tenderness. The blood urea on admission was 70 mg/100 ml. An Astrup test showed a respiratory alkalosis. A chest x-ray showed no lesion. The serum paraquat level on admission was 94 ug/100 ml. The urinary paraquat level was 197 ug/100 ml. The serum S.G.O.T. was 65 K units but there was no other evidence of liver damage.

The patient remained almost anuric for 4 days after admission but thereafter achieved satisfactory diuresis. He was treated with peritoneal dialysis for 6 days, intravenous fluids, sedation and oxygen. His blood urea gradually fell to a normal level. Six days after admission small amounts of paraquat were still present in the urine. No paraquat was found in the dialysate at any stage. A chest x-ray 10 days after admission showed a small patch of consolidation in the right lower zone, with a small left-sided basal effusion. He was given a course of intramuscular penicillin. Subsequent chest x-rays were clear. He was discharged sixteen days after admission. A week later his blood urea was normal and a M.S.S.U. was clear of cells or protein. 3 months later he remained well.

DISCUSSION

Paraquat and diquat are bipyridilium compounds much used in agriculture as surface-contact herbicides. They are believed to be continuously reduced and re-oxidized in the presence of chlorophyll with the gradual accumulation of hydrogen peroxide to toxic levels. They are inactivated by contact with soil, possibly because of the cation-capturing effect of silicates contained in it. There is a minimum dose beneath which dietary paraquat causes no apparent damage and an intermediate dose which on long term consumption produces pulmonary fibrosis in animals (Conning et al, 1969; Daniel and Gage, 1966). Paraquat is poorly absorbed, over 70 per cent appearing in the faeces, and in addition there is evidence that it is degraded by microbiological action in the intestinal tract. It is more rapidly absorbed in fasting than in recently fed animals (Clark et al, 1966) and this may also apply in cases of human poisoning (Greig, quoted by Matthew et al, 1968). It is rapidly excreted in experimental animals (Daniel and Gage, 1966) and this led to the suggestion that it is a "hit and run" poison, since the pulmonary lesions progressed in the absence of further dosage. However, in man, it continues to be excreted for many days in the urine (Tompsett, 1970).

This species variation casts some doubt on the value of animal experiments.

The severe effects of poisoning by bipyridilium compounds are well known. Although small amounts of "Weedol" (5 per cent paraquat) or paraquat and diquat mixtures such as "Dextrone" do not appear to be fatal, herbicides with a higher concentration, such as Gramoxone W (20 per cent paraquat) have a very bad record. The "typical victim" takes a mouthful of 20 per cent paraquat, which he at once spits out, but he later dies, usually of renal or late progressive pulmonary damage, although gastro-intestinal, hepatic and myocardial lesions are also often found. However, the outcome is not always predictable and several patients have recovered fully. Some die in spite of intensive treatment with forced diuresis, and haemodialysis or peritoneal dialysis. Others recover without treatment. (See Malone et al, 1971, for a comprehensive review of their own cases and the literature). In general, the more severe the objective evidence of organ damage, the less likely the patient is to survive. The absence of pulmonary lesions makes survival more likely. Steroids and immuno-suppression have been used in an effort to halt renal and late pulmonary damage, but it is admitted that there is no convincing evidence of their value. Very little paraquat is removed by dialysis (Tompsett, 1970; Carson, 1972), although removal by haemodialysis may be comparable to urinary excretion. Urinary excretion may be increased by forced diuresis (Kerr et al, 1968). In the presence of acute renal failure due to paraquat-induced tubular necrosis, dialysis may of course be essential to maintain life, and it is then the only route of excretion available.

Of the cases reported here, the first two belong to the category in which recovery may be expected, since small amounts of paraquat in low concentration were taken. The third case belongs to the category in which the outcome is very often fatal. Treatment with peritoneal dialysis, although it did not remove detectable amounts of paraquat, will have lessened the systemic effects of the patient's early acute renal failure. However, since toxic effects are related to dose, it is reasonable to assume that *all* possible measures to prevent absorption, increase excretion, maintain the patient and prevent progressive organ damage are justified in cases of this sort. They are unlikely to harm the patient, who may die for the lack of them.

The following measures are therefore suggested in all cases in which the outcome is unpredictable. They are based on what is known of the poison's absorption and fate, and of the response of individual patients to treatment.

1. Immediate ejection of the swallowed dose followed by washing of the mouth and inducement of vomiting.
2. Gastric lavage, although care is necessary to avoid the possibility of perforation of the oesophagus, which may be corroded (Malone et al, 1971).
3. Instillation of 1-2 litres of 7 per cent suspension of Bentonite as soon as possible. Bentonite is a colloidal hydrated silicate, capable of removing cationic substances from solution by a cation-exchange mechanism.
4. Transfer to an intensive care unit.
5. Encouragement of an oral diet, if tolerated, or tube-feeding, unless severe oesophageal damage forbids it.

6. Establishment of diuresis. If possible paraquat urinary excretion should be measured daily.
7. Cyclophosphamide 3 mg./kg., and Prednisolone 1 mg./kg., daily, even though the evidence that they help is inconclusive.
8. Peritoneal dialysis or haemodialysis especially if acute renal failure has developed, when it is the only means of maintaining the patient and excreting the poison.
9. Intensive respiratory care has been used in those surviving long enough or requiring it. Recently, it has been suggested that far from being helpful, oxygen therapy is definitely contra-indicated (Matthew, 1971; Fletcher, 1973).

Only from a survey of a large number of patients treated in this way can it be known whether treatment contributes to survival in cases where the history makes the prognosis unpredictable.

In cases where survival seems likely (such as numbers 1 and 2 in the cases above) the regime may not need to be imposed. In cases where larger amounts of highly concentrated paraquat are consumed, no present treatment is likely to have any effect.

Paraquat has been marketed for 11 years, and the manufacturers record just over 70 cases of fatal accidental poisoning by the concentrated liquid up to 1972. There have been 11 fatal cases reported in Northern Ireland, of which 7 were probably accidental. All the accidental deaths resulted from drinking concentrated solution which had been decanted into unmarked bottles. The farming community prefers to use the concentrated solution, because it is easy to store and is ready for use in herbicidal sprayers. Manufacture of paraquat in a jelly form or as concentrated granules has been considered and is much to be desired if it can be made practicable. If not, the addition of a noxious smell to the concentrate might prevent the unwary quaffing of decanted potions.

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